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SUPPLEMENT TO 1941 NORTH DAKOTA ANNUAL PLANTING AND NURSERY REPORTS, AND RECORD OF SPRING 1942 FIELD PLANTING AND TRANSPLANTING

Joseph H. Stoeckeler

V-E

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

SUPPLEMENT TO 1941 NORTH DAKOTA ANNUAL PLANTING AND NURSERY REPORTS, AND RECORD OF SPRING 1942 FIELD PLANTING AND TRANSPLANTING

By

Joseph H. Stoeckeler
June 1942

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EXPERIMENT STATION

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SUPPLEMENT TO 1941 NORTH DAKOTA ANNUAL PLANTING AND NURSERY REPORTS, AND RECORD OF SPRING 1942 FIELD PLANTING AND TRANSPLANTING

DENBIGH ARBORETUM

The Denbigh arboretum was started in 1940 by converting the Denbigh nursery into an arboretum of 44 blocks, each 30' x 30' in size and generally containing 100 trees spaced 3' x 3'. In a few cases, fewer trees were used. In the spring of 1942 the plantings were completed and it is anticipated that most of the plots will be reasonably well stocked, considering the fact that replanting of failed trees was done in the spring of 1942.

The status of the arboretum as of June 15, 1942 is shown in table 1. A few of the plots, especially 37 and 38, may need replanting with an entirely different species if they fail too badly. These plots were 1-0 black locust, which had been chewed back to the ground line by rabbits while the stock was at the Towner Nursery. Also, a good deal of the stock had been winter killed, as shown by soft spongy watery appearance of the roots, and even though culling was done the arboretum stand may not be very good. It is felt that,even if only a 20 or 30 percent stand is obtained, the plots may be worth retaining because a few trees might have the necessary hardiness to pull through the rigorous winters and in time produce seed.

Larger lots of these northern sources of black locust were planted in the field at Denbigh in the spring of 1942 and, if these show a fair stand, the field plantings may suffice for demonstration

purposes and it would not be so necessary to keep the two arboretum plots of black locust.

It is also probable that a little replanting will have to be done in any plots put in during the spring of 1942. To get replant material, there are six sources: (1) Surplus stock lined out at west end of Denbigh arboretum in the spring of 1942. (2) A few rows of surplus stock received from E. E. Aamodt and taken from Wisconsin and Michigan nurseries in the spring of 1942 for arboretum planting at Denbigh. (3) One long east-west row of assorted conifers just north of Denbigh arboretum. (4) Transplants put in at Towner in the spring of 1940 between pipe lines 6 and 8. (5) Transplants put in at Towner Nursery in the spring of 1942 between pipe lines 4 and 6. (6) Field plantations at Denbigh from which a few trees of a specific seed source could be dug without affecting survival figures by more than one or two percent.

The location of these lots and their descriptions are given in subsequent chapters in this report and classified as "Stock lined out at Denbigh Arboretum," "Transplanting Towner Nursery 1942," and "Other stock available at Towner Nursery." Any of these sources can be used since all lots are identified and marked with stakes and metal tags.

ORNAMENTAL PLANTING AT DENBIGH

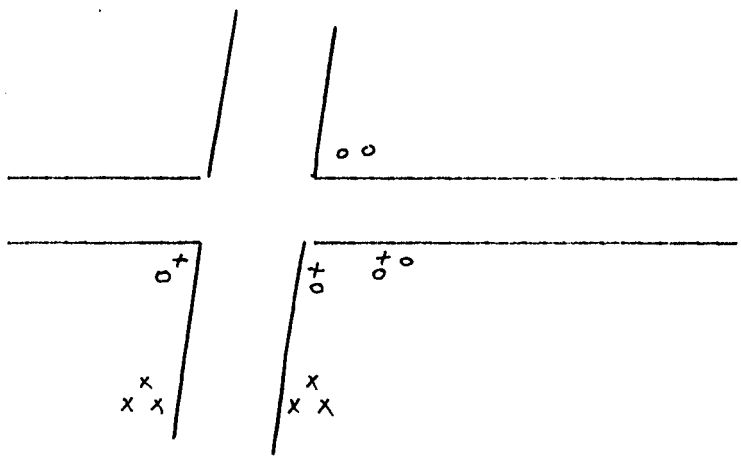
The ornamental planting at Denbigh has been largely completed to fill in a long-range plan. A few replants and some new planting was done in April and May, 1942.

Table 1.--Status of Denbigh Arboretum as of June 15, 1942.

Plot No.	Species	Age class: First planting	Age class: Re-planting	Date planting: First planting	Date planting: Re-planting	No. trees planted: First planting	No. trees planted: Re-planting	No. trees planned per plot	Col. No.	Seed source
1	Black spruce	2-1			5-22-42	~~100~~ 90		~~100~~ 100		Superior National Forest, Minnesota
2	Cottonwood	1-0	2-0	6-6-40	4-24-42	100	6	100		Mandan, North Dakota
3	American elm	2-1		6-7-40		100		100		North Dakota
4	Ponderosa pine	2-2	2-2-2	6-7-40	5-10-42	100	17	100	380	Western Nebraska.
5	White cedar	3-2		5-22-42		100		100		Chequamegon National Forest, Wisconsin
6	Balsam fir	5-2		April '42		84		84	378	Chippewa National Forest, Minnesota
7	Jack pine	3-2		5-13-42		100		100	399	Chippewa National Forest, Minnesota
8	Siberian larch (L. siberica)	3-1	3-3	6-6-40	4-21-42	100	9	100	383	Probably Russia (Rec'd from J. Rafn)
9	Mixture of P. leucosperma, ponderosa and Scotch pine	2-1	2-3	6-13-40	4-24-42	100	6	100	289	Keijo, Chosen, Japan
10	Norway spruce	2-4		5-22-42		100		100		Chequamegon National Forest, '35, Wis.
10A	Basswood	2-0		5-22-42		100		100		Chequamegon National Forest, Wisconsin
11	Tamarack (L. laricina)	2-5		4-24-42		70		70	379	Superior National Forest, Minnesota
12	Hackberry	1-3-1		6-6-40		100		100	321	McHenry County, North Dakota
13	Ponderosa pine	3-2		6-7-40	4-21-42	100	35 1/	100	318	Medora, North Dakota
14	Ponderosa pine	3-2	3-2-2	6-7-40	4-23-42	100	6	100	376	Black Hills, South Dakota
15	Ponderosa pine	2-2-1	2-2-3	6-12-40	4-21-42	100	12	100	364	Glendive, Montana
16	Red pine	2-2	2-2	5-20-41	5-22-42	100	100	100		Nicolet National Forest, Wisconsin
17	Rock elm (U. thomasii)	2½-0		5-22-42		100		100		Nicolet National Forest, Wisconsin
2/18	Black haw (Viburnum lentago)	3-2		4-25-42		17		17		Devils Lake, North Dakota
3/ 18	Pyramidal juniper (J. pyramidalis)	4-2		6-10-40		25		25		Medora, North Dakota
19	Rocky Mountain red cedar (J. scopulorum)	2-2	2-2-2	6-17-40	5-10-42	100	10	100	361	Medora, North Dakota
20	Hard maple	1-0		MAY-42		100		100		Nicolet National Forest, Wisconsin
20A	Scotch pine	2-2-2		5-13-42		100		100	385	Finland
21	Not planted; leave empty									
22	Colorado blue spruce	3-2	3-2-2	5-21-41	4-24-42	100	7	100	405	Colorado
23	Black Hills spruce	3-4		5-14-41		100		100	330	Custer, South Dakota
24	Russian golden willow	Cuttings	Cuttings	6-10-40	4-22-42	100	67	100		McHenry County, North Dakota
25	Russian mulberry	1-4	1-6	6-12-40	4-23-42	100	7	100		Kansas or Oklahoma
26	Rocky Mountain red cedar	3-2	3-3	5-23-41	4-24-42	100	54	100	367	Butte Creek, Montana
27	Mountain ash	3-0			5-23-42	100		100		Nicolet National Forest, Wisconsin
28	Ginnala maple	2-0			4-23-42	93		93	419	Far East of U.S.S.R.
29	Boxelder	2-0	2-0	6-18-40	4-23-42	100	4	100	A-38-39	North Dakota
30	Manchurian ash	1-0		4-26-42		100		100	454A	All Union Res. Inst. Moscow
30A	Chinese juniper (J. chinensis)	3-2		4-26-42		100		100	402	Keijo, Chosen, Japan
31	Austrian pine (P. austriaca) 4/	2-1-5		5-22-41		68		68		Obtained from Bottineau Nursery
32	White spruce	4-4	4-5	5-21-41	4-23-42	70	67	100	335	Minnesota and Wisconsin
33	Dwarf juniper (J. communis)	5-0		6-10-40		80		80	342	La Crosse, Wisconsin
34	Russian olive	5-0		6-10-40		100		100	326	Minot, North Dakota
35	Tamarix (T. pentandra amurensis)	Cuttings		6-11-40	4-23-42	100	76	100		Amur River, U.S.S.R.
36	Limber pine	4-2	4-1-2	5-23-41	4-25-42	100	66		371	Pole Mountains, Cheyenne, Wyo.
37	Black locust	1-0		5-3-42		100		100		Idaho
38	Black locust	1-0		4-25-42		100		100	504	E. Tawas, Michigan
39	Eastern red cedar (J. virginiana)	1-1		4-26-42		100		100		Oakes, North Dakota (Shelterbelt planting)
40	Diamond willow	Cuttings		4-26-42		100		100		Larimore, North Dakota
40A	Mugho pine	Est. 2-4		5-23-42		100		100		(From Hayward Nursery, Herbst Bros. N.Y. seed)

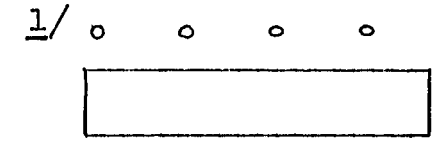
1/ There were only 48 trees alive before replanting plot and 83 were alive after spring 1942 replanting.
2/ North part.
3/ South part.
4/ There were 48 trees surviving by spring 1942 in Plot 31.

1. At entrance on U.S. No. 2, six 2-2½ foot Scotch pine were planted, as were six 1.5 foot blue spruce and three J. communis. The plan is shown below:



x - Scotch pine
o - blue spruce
+ - J. communis

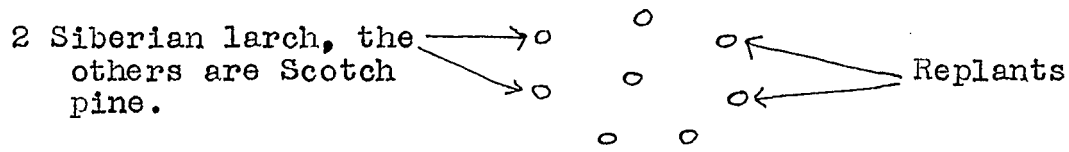
2. One 1½ foot ponderosa pine, C-370, age 7 (from seed bed 167 at Denbigh) was balled and burlapped and moved to front of house on May 2.



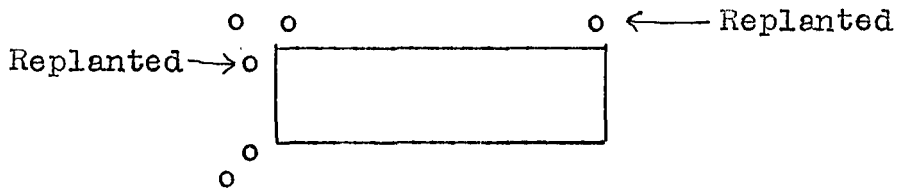
1/ This tree planted this spring.

3. One 12-inch Colorado blue spruce was planted May 2 about 10 feet south of the golden willow at the most northerly end of the Caragana oval north of residence.

4. In the Scotch pine and Siberian larch group of 8 trees about 200 feet east southeast of the windmill, 2 Scotch pine were replaced about April 25 with 2-foot trees of the same species taken out of center of Denbigh nursery.

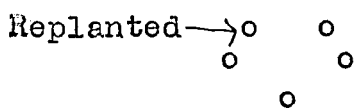


5. Two J. scopulorum about 2 feet high were balled and burlapped and replanted near garage on May 2.



6. Just west of the implement shed a group of 5 Oxford hybrid poplar, either lot 155-9 or 33-9, were planted on April 30, 1942 to replace the cottonwoods which had been split by snow.

7. In the group of 5 ponderosa pine about 100 feet east southeast of the arboretum gate, replaced one tree with a 1-foot tree from the north part of the west bed of overgrown transplants at Denbigh. Age 2-5, Col. 370.



STOCK LINED OUT AT DENBIGH ARBORETUM

Stock lined out at the west end of the Denbigh arboretum for replanting purposes is shown in figure 1. Some of the stock, such as diamond willow, could be used for field planting in the spring of 1943 as rooted 1-0 cuttings.

At the north side of the arboretum there is a single long row about 10 feet north of subplots 1 to 10, and this also contains plants that can, in a pinch, be used for arboretum replants. The distances from the east boundary fence of the arboretum for each lot are shown in table 2. As an example in using the table, it is seen that the Siberian larch, C-383, extends from 49 feet west to 88 feet west of the east boundary, or occupies 38 lineal feet of row.

Some surplus stock of 8 or 9 lots and amounting to some 40 to 150 trees each is also lined out in the east end of the source of seed green ash plot, about 80 feet south of the garage. These species include black spruce, white cedar, Norway spruce, basswood, red pine, American elm, hard maple, and mountain ash.

STOCK TRANSPLANTED SPRING 1942 AT TOWNER NURSERY

In the spring of 1942, between May 6 and 8, trees were transplanted at Towner Nursery between pipe lines No. 4 and 6 just to the west of the Nursery office building for the purpose of providing some replant stock to fill in thin plantations at Denbigh, to save certain lots of stock of potentially valuable seed sources such as the Finnish and Leningrad Scotch pine, and to provide some stock for use in the North Dakota State Forester's Clark-McNary

Figure 1 Miscellaneous stock lined out at west end of Dem[illegible] Nursery on May 2, 1942. [illegible]es as of Spring 194[illegible]

Fence

Row No.	Arboretum Plot No. 11	Arboretum Plot No. 1
14		Chinese juniper
13		Chinese juniper
12	Tamarix pentandra amurense	Siberian larch Bed 1246 / J. scop. Bed 1395 / Siberian larch Bed 1264 / Acer insigne
11	Golden willow cuttings	3-0 Scotch Pine C-427 / Doug.fir Col. 409 / Siberian larch Col. 383. 1936 / Siberian larch Bed 1247 / Siberian larch Bed 1246
10	Cuttings of Diamond willow, Larimore Camp, N. Dak.	Top pruned C376. / 3-0 Scotch pine. Col. 385 / 3-0 Scotch pine Col. 427
9	Cuttings of Diamond willow, Larimore Camp, N. Dak.	Top pruned 3-0 ponderosa pine, C-376
8	Cuttings of Diamond willow, Larimore Camp, N. Dak.	Top pruned 3-0 ponderosa pine, C-376
7	Black Hills spruce / Scotch pine	Unpruned 3-0 ponderosa pine, C-376
6	Colo. blue spruce / Black Hills spruce	1-1 J. virginiana, Oakes, N. D. / 2-2 J. scopulorum, C-387
5	Colorado blue spruce	2-2 ponderosa pine, Col. 438. (no tags)
4	Colorado blue spruce	2-2 ponderosa pine, Col. 438. (no tags)
3	Colorado blue spruce	Scotch pine ornamentals / Limber pine Col. 371 N ½ bed 168 May 1935 / 2-2 ponderosa pine Col. 438
2	Colorado blue spruce	Scotch pine ornamentals
1	Colorado blue spruce	Scotch pine ornamentals
0	3-2 Jack pine C-399	3-2 Jack pine C-399

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Table 2.--Distance in feet west from east fence of Denbigh Arboretum of miscellaneous lots of trees planted in one single east-west row at north side. Spring 1942

0	=	East fence.
49	=	SB 295 Larix siberica, C. 383, June 1936.
88	=	SB 186 J. virginiana, C. 367, May 1935
135.5	=	SB 132 Picea glauca albertiana, C. 330.
220.5	=	P. glauca albertiana, age about 8 years.
287	=	Blue spruce, C. 406.
319	=	2-2 Ponderosa, C. 376, Harney National Forest (6 trees)
330.5	=	2-2 Ponderosa, C. 365.
370	=	2-2 Ponderosa pine, #253.
423	=	Mixed Black Hills and Colorado blue spruce.
486	=	SB 113 Juniperus monosperma, C. 338.
494	=	SB 393 Ulmus montana, C. 434 (4 plants).
500	=	West end of planting.
540.5	=	West fence running north to south.
548.5	=	North-south Caragana hedge at west edge of arboretum.

program against whose funds some money has been drawn for operation of the Denbigh Station. A few of the lots will be used to do landscape planting at Towner and Denbigh.

The species, age class, collection number, source and layout of the area are shown in figure 2. The distances in feet shown on the sketch represent distances in feet west from the east end of the area, starting near the nursery office.

Each lot has a stake with a metal tag attached to it at the east end of the lot and a 1.0- to 1.5-foot gap was left between separate lots. However, in case stakes should be knocked down or inadvertently pulled, this sketch map will be an aid in separating lots. The trees transplanted in the spring of 1942 in this area are listed in table 3.

OTHER STOCK AVAILABLE AT TOWNER NURSERY FOR FIELD PLANTING

1. Between pipe lines 34 and 36 north of the Towner Nursery pumphouse there are 17 rows of transplants, each 480 feet long, spaced 2 inches apart in the rows. These will be 2-2 age class in the fall of 1942, since they were transplanted in the spring of 1941. The stock belongs to the Experiment Station and will be available for field planting, distribution to the State Forester, or transfer to the Shelterbelt Project. There were 48,960 trees in the 17 rows and, figuring a cull and failure factor of 15 percent, there should be close to 40,000 trees in this block. The stock is Col. 440 and source is Miles City, Montana. Whether the 15 percent factor is high enough is problematical, since in the spring of 1942 there were 1600 usable trees per row in a lot sent to Bottineau and it may be there will be only 30,000 usable trees. Any surplus left after distribution in the spring of 1943 could be top pruned and left for 2-3 stock.

Table 1.--Status of Denbigh Arboretum as of June 15, 1942.

Plot No.	Species	Age class: First planting	Age class: Re-planting	Date planting: First planting	Date planting: Re-planting	No. trees planted: First planting	No. trees planted: Re-planting	No. trees planned per plot	Col. No.	Seed source
1	Black spruce	2-1			5-22-42	100		100		Superior National Forest, Minnesota
2	Cottonwood	1-0	2-0	6-6-40	4-24-42	100	6	100		Mandan, North Dakota
3	American elm	2-1		6-7-40		100		100		North Dakota
4	Ponderosa pine	2-2	2-2-2	6-7-40	5-10-42	100	17	100	380	Western Nebraska.
5	White cedar	3-2		5-22-42		100		100		Chequamegon National Forest, Wisconsin
6	Balsam fir	5-2		April '42		84		84	378	Chippewa National Forest, Minnesota
7	Jack pine	3-2		5-13-42		100		100	399	Chippewa National Forest, Minnesota
8	Siberian larch (L. siberica)	3-1	3-3	6-6-40	4-21-42	100	9	100	383	Probably Russia (Rec'd from J. Rafn)
9	Mixture of P. leucosperma, ponderosa and Scotch pine	2-1	2-3	6-13-40	4-24-42	100	6	100	289	Keijo, Chosen, Japan
10	Norway spruce	2-4		5-22-42		100		100		Chequamegon National Forest,'35, Wis.
10A	Basswood	2-0		5-22-42		100		100		Chequamegon National Forest, Wisconsin
11	Tamarack (L. laricina)	2-5		4-24-42		70		70	379	Superior National Forest, Minnesota
12	Hackberry	1-3-1		6-6-40		100		100	321	McHenry County, North Dakota
13	Ponderosa pine	3-2		6-7-40	4-21-42	100	35 1/	100	318	Medora, North Dakota
14	Ponderosa pine	3-2	3-2-2	6-7-40	4-23-42	100	6	100	376	Black Hills, South Dakota
15	Ponderosa pine	2-2-1	2-2-3	6-12-40	4-21-42	100	12	100	364	Glendive, Montana
16	Red pine	2-2	2-2	5-20-41	5-22-42	100	100	100		Nicolet National Forest, Wisconsin
17	Rock elm (U. thomasii)	2½-0		5-22-42		100		100		Nicolet National Forest, Wisconsin
2/18	Black haw (Viburnum lentago)	3-2		4-25-42		17		17		Devils Lake, North Dakota
3/ 18	Pyramidal juniper (J.pyramidalis)	4-2		6-10-40		25		25		Medora, North Dakota
19	Rocky Mountain red cedar (J. scopulorum)	2-2	2-2-2	6-17-40	5-10-42	100	10	100	361	Medora, North Dakota
20	Hard maple	1-0		MAY-42		100		100		Nicolet National Forest, Wisconsin
20A	Scotch pine	2-2-2		5-13-42		100		100	385	Finland
21	Not planted; leave empty									
22	Colorado blue spruce	3-2	3-2-2	5-21-41	4-24-42	100	7	100	405	Colorado
23	Black Hills spruce	3-4		5-14-41		100		100	330	Custer, South Dakota
24	Russian golden willow	Cuttings	Cuttings	6-10-40	4-22-42	100	67	100		McHenry County, North Dakota
25	Russian mulberry	1-4	1-6	6-12-40	4-23-42	100	7	100		Kansas or Oklahoma
26	Rocky Mountain red cedar	3-2	3-3	5-23-41	4-24-42	100	54	100	367	Butte Creek, Montana
27	Mountain ash	3-0			5-23-42	100		100		Nicolet National Forest, Wisconsin
28	Ginnala maple	2-0			4-23-42	93		93	419	Far East of U.S.S.R.
29	Boxelder	2-0	2-0	6-18-40	4-23-42	100	4	100	A-38-39	North Dakota
30	Manchurian ash	1-0		4-26-42		100		100	454A	All Union Res. Inst. Moscow
30A	Chinese juniper (J. chinensis)	3-2		4-26-42		100		100	402	Keijo, Chosen, Japan
31	Austrian pine (P. austriaca)	4/ 2-1-5		5-22-41		68		68		Obtained from Bottineau Nursery
32	White spruce	4-4	4-5	5-21-41	4-23-42	70	67	100	335	Minnesota and Wisconsin
33	Dwarf juniper (J. communis)	5-0		6-10-40		80		80	342	La Crosse, Wisconsin
34	Russian olive	5-0		6-10-40		100		100	326	Minot, North Dakota
35	Tamarix (T. pentandra amurensis)	Cuttings		6-11-40	4-23-42	100	76	100		Amur River, U.S.S.R.
36	Limber pine	4-2	4-1-2	5-23-41	4-25-42	100	66		371	Pole Mountains, Cheyenne, Wyo.
37	Black locust	1-0		5-3-42		100		100		Idaho
38	Black locust	1-0		4-25-42		100		100	504	E. Tawas, Michigan
39	Eastern red cedar (J.virginiana)	1-1		4-26-42		100		100		Oakes, North Dakota (Shelterbelt planting)
40	Diamond willow	Cuttings		4-26-42		100		100		Larimore, North Dakota
40A	Mugho pine	Est. 2-4		5-23-42		100		100		(From Hayward Nursery, Herbst Bros. N.Y. seed)

1/ There were only 48 trees alive before replanting plot and 83 were alive after spring 1942 replanting.
2/ North part.
3/ South part.
4/ There were 48 trees surviving by spring 1942 in Plot 31.

Figure 1 Miscellaneous stock lined out at west end of Dem[illegible] Nursery on May 2, 1942. [illegible]es as of Spring 194[illegible]

Fence

Row No.	Arboretum Plot No. 11	Arboretum Plot No. 1
14		Chinese juniper
13		Chinese juniper
12	Tamarix pentandra amurense	Siberian larch Bed 1246 / J. scop. Bed 1395 / Siberian larch Bed 1264 / Acer insigne
11	Golden willow cuttings	3-0 Scotch Pine C-427 / Doug.fir Col. 409 / Siberian larch Col. 383. 1936 / Siberian larch Bed 1247 / Siberian larch Bed 1246
10	Cuttings of Diamond willow, Larimore Camp, N. Dak.	Top pruned C376. / 3-0 Scotch pine. Col. 385 / 3-0 Scotch pine Col. 427
9	Cuttings of Diamond willow, Larimore Camp, N. Dak.	Top pruned 3-0 ponderosa pine, C-376
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6	Colo. blue spruce / Black Hills spruce	1-1 J. virginiana, Oakes, N. D. / 2-2 J. scopulorum, C-387
5	Colorado blue spruce	2-2 ponderosa pine, Col. 438. (no tags)
4	Colorado blue spruce	2-2 ponderosa pine, Col. 438. (no tags)
3	Colorado blue spruce	Scotch pine ornamentals / Limber pine Col. 371 N ½ bed 168 May 1935 / 2-2 ponderosa pine Col. 438
2	Colorado blue spruce	Scotch pine ornamentals
1	Colorado blue spruce	Scotch pine ornamentals
0	3-2 Jack pine C-399	3-2 Jack pine C-399

-6-

Fig [illegible].--Towner Nursery transplanting, spring 1942, between pipe lines No. 4 and 6 just west of Nursery Office.

E S W N

Planting ends at 328 feet

Pipe line

1	2-0 J. communis, Bed 1388 (147 ft.)	2-0 J. scopulorum, Bed 1389, Col. 398	(389.5 ft. at S.E. corner bed 1386.)
2	2-0 J. scopulorum, Bed 1393, C-440 (135 ft.)	2-0 J. scopulorum, Bed 1387, C-407 (317 ft.)	2-0 J. scopulorum, Bed 1389, C-398
3	2-0 J. scopulorum, Bed 1393, C-440 (157 ft.)	2-0 J. scopulorum, Bed 1394, C-437	
4	2-0 J. scopulorum, Bed 1394, C-437		
5	2-0 J. scopulorum, Bed 1394 (211 ft.)	3-0 blue spruce	
6	3-0 blue spruce		
7	3-0 blue spruce		
8	3-0 blue spruce		
9	3-0 blue spruce (271 ft.)	3-0 Scotch pine, C-427 Leningrad	
10	3-0 Scotch pine, C-427, Leningrad		
11	3-0 Scotch pine, C-427, Leningrad		
12	3-0 Scotch pine, C-427, Leningrad		
13	3-0 Scotch pine, C-427, Leningrad		
14	3-0 Scotch pine, C-427, Leningrad		
15	3-0 Scotch pine, C-427, Leningrad (186 ft.)	Top pruned 3-0 ponderosa pine, C-376	
16	Not top pruned 3-0 ponderosa pine, C-376 (156 ft.)	Top pruned 3-0 ponderosa pine, C-376	
17	Unpruned 3-0 ponderosa pine, C-441, Fallon, Montana		

Note: It is 61 feet from end of east end of tree rows to northwest corner of office building at Towner Nursery. In row 1, 2-0 J. communis is 4" apart in row; rest of row 1 is 2" spacing. Rows 2, 3, 4, 5, 6 are all 2" space in row.
Rows 1-6 transplanted May 6, 1942. Rows 7-11½ transplanted May 7, 1942, including west half row 12.
Rows 11½-17 transplanted May 8, 1942, including east half row 12.

Fig [illegible].--Towner Nursery transplanting, spring 1942, between pipe lines No. 4 and 6 just west of Nursery Office.

E S W N

Planting ends at 328 feet

Pipe line

1	2-0 J. communis, Bed 1388 (147 ft.)	2-0 J. scopulorum, Bed 1389, Col. 398	(389.5 ft. at S.E. corner bed 1386.)
2	2-0 J. scopulorum, Bed 1393, C-440 (135 ft.)	2-0 J. scopulorum, Bed 1387, C-407 (317 ft.)	2-0 J. scopulorum, Bed 1389, C-398
3	2-0 J. scopulorum, Bed 1393, C-440 (157 ft.)	2-0 J. scopulorum, Bed 1394, C-437	
4	2-0 J. scopulorum, Bed 1394, C-437		
5	2-0 J. scopulorum, Bed 1394 (211 ft.)	3-0 blue spruce	
6	3-0 blue spruce		
7	3-0 blue spruce		
8	3-0 blue spruce		
9	3-0 blue spruce (271 ft.)	3-0 Scotch pine, C-427 Leningrad	
10	3-0 Scotch pine, C-427, Leningrad		
11	3-0 Scotch pine, C-427, Leningrad		
12	3-0 Scotch pine, C-427, Leningrad		
13	3-0 Scotch pine, C-427, Leningrad		
14	3-0 Scotch pine, C-427, Leningrad		
15	3-0 Scotch pine, C-427, Leningrad (186 ft.)	Top pruned 3-0 ponderosa pine, C-376	
16	Not top pruned 3-0 ponderosa pine, C-376 (156 ft.)	Top pruned 3-0 ponderosa pine, C-376	
17	Unpruned 3-0 ponderosa pine, C-441, Fallon, Montana		

Note: It is 61 feet from end of east end of tree rows to northwest corner of office building at Towner Nursery. In row 1, 2-0 J. communis is 4" apart in row; rest of row 1 is 2" spacing. Rows 2, 3, 4, 5, 6 are all 2" space in row.
Rows 1-6 transplanted May 6, 1942. Rows 7-11½ transplanted May 7, 1942, including west half row 12.
Rows 11½-17 transplanted May 8, 1942, including east half row 12.

Table 3.--Trees transplanted in the spring of 1942 between pipe lines 4 and 6, Towner Nursery, North Dakota.

No. of trees	No. of rows*	Age	Species	Col. No.	Bed No.
440	0.448	2-0	J. communis		1388
1,130	0.546 + 0.03	2-0	J. scopulorum	398	1389
1,080	0.55	2-0	J. scopulorum	407	1387
1,760	0.412 + 0.479	2-0	J. scopulorum	440	1393
4,250	1.0 + 0.516 + 0.643	2-0	J. scopulorum	437	1394
8,220	0.351 + 0.826 + 3 full rows	3-0	Blue spruce		
11,290	0.168 + 0.567 + 5 full rows	3-0	Scotch pine	427	
1,860	0.424 + 0.519	3-0	Top pruned Ponderosa pine	376	
940	0.476	3-0	Unpruned Ponderosa pine	376	
1,970	1.0 row	3-0	Unpruned Ponderosa pine	441	
32,940	Total				

*Full rows are 328 feet long. All lots with 2-inch space between plants except the J. communis, which was 4 inches.

2. Between pipe lines 6 and 8 there are the following lots of stock available for field planting as shown in table 4. Age classes listed are as of fall of 1942. All this stock was given a top dressing of ammonium sulphate and nitrophoska on May 14. The treatment given was 3 lbs. of nitrophoska/on 264 square feet of bed of Colorado blue spruce and on 21 square feet of Black Hills spruce. The juniper, which occupies about 207 actual lineal feet of bed 6 feet wide with an area of 1242 square feet, received 8 pounds of 20 percent ammonium sulphate and 8 pounds of 15-30-15 nitrophoska. This stock was transplanted at 1½-inch spacing or 48 per row or board.

EXPERIMENTAL SEED BEDS AT TOWNER NURSERY ON WHICH MORE DATA IS NEEDED

At the Towner Nursery between pipe lines 4 and 6 there are a number of plots involving experiments which should be followed up at least through the fall of 1942. These are shown in table 5.

At the Towner Nursery between pipe lines 16 and 18 there are two 4x4 latin squares involving Scotch pine (table 6).

Besides these plots there is a 50-foot long seed bed of ponderosa pine from Fallon, Montana, Col. 453, which was sown June 9, 1941 and averaged about 35 trees per square foot in the fall of 1941, and can be transplanted.

Figures 3 and 4 show the layout of the various Experiment Station seed beds at the Towner Nursery. Tables 7 to 11, inclusive, give details of treatment in the beds between pipe lines 4 and 6, the map for which is shown in figure 3. Figure 4 has details of fertility and acid treatment for the beds north of pipe line 16.

Weight data have already been obtained in the fall of 1941 on the 2-0 Colorado blue spruce in beds 1387-1411, and this showed a marked response from acid treatment. In the 2-0 J. scopulorum in beds 1287-1386, excellent response was observed in the fall of 1941

Table 4.--Transplant stock between pipe lines 6 and 8 at Towner Nursery in 1942.

Approx. No. plantable trees	No. of rows	Age class*	Species	Col. No.	Seed bed	Source
500	16	3-3	Blue spruce	420	385	Colorado
2,500	72	3-3	Blue spruce	426	386	Colorado
200	7	3-3	Black Hills spruce	424	389, 390, 391	South Dakota
700	21	2-3	J. scopulorum	403	362	Medora, N.Dak.
500	18.75	2-3	J. scopulorum	403	363	Do
400	13	2-3	J. scopulorum	425	426D	Meridan, Wyo.
300	8.5	2-3	J. scopulorum	403	398	Medora, N.Dak.
900	30.5	2-3	J. scopulorum	398	345	Ashland, Mont.
50	2	2-3	J. scopulorum	418	372	Beach, N.Dak.
100	4	2-3	J. scopulorum	403	365	Medora, N.Dak.
200	8	2-3	J. scopulorum	425	425D	Meridan, Wyo.
100	4.75	2-3	J. scopulorum	382	S¼ 373	Custer, S.Dak.
800	31	2-3	J. scopulorum	425	428D	Meridan, Wyo.
1,200	41	2-3	J. scopulorum	425	422D	Do
300	15	2-3	J. scopulorum	421	409D	Camp Crook, S.Dak.
8,750	Total					

Recapitulation by seed sources

Approx. No. plantable trees	Age class*	Species	Col. No.	Seed source
3,000	3-3	Blue spruce	420	Colordao
200	3-3	Black Hills spruce	424	South Dakota
1,600	2-3	J. scopulorum	403	Medora, N. Dak.
50	2-3	J. scopulorum	418	Beach, N. Dak.
100	2-3	J. scopulorum	382	Custer, S. Dak.
300	2-3	J. scopulorum	421	Camp Crook, S. Dak. (Camp F-19)
2,600	2-3	J. scopulorum	425	Shell Creek Canyon, Bighorn National Forest Meridan, Wyo.
900	2-3	J. scopulorum	398	Ashland, Mont. (Camp F-54)
8,750	Total			

s of Fall 1942. Transplanting was done in the spring of 1940.

Table 5.--Seed beds at Towner Nursery between pipe lines 4 and 6.

Beds	No. of beds	Species	Date sown	Date germinated	Type and object of experiment
1521-1544	24	J. scopulorum C-452. Fallon, Mont.	10-10-40	Spring 1941 1/	4 Replications of 6 methods of fertilizing and acidifying.
1545-1560	16	Colorado blue spruce C-456. Pike National Forest, Colorado	10-10-40	Spring 1941	A 4x4 latin square on acidification, fertilization, and mycorrhizal introduction.
1496-1505	10	J. scopulorum C-440. Miles City, Mont.	9-27-41	Spring 1942	Reseeding of failed density experiment. Not in experimental status now.
1506-1520	15	J. scopulorum C-452. Fallon, Mont.	9-27-41	Spring 1942	
1387-1411	25	Colorado blue spruce C-456. Pike National Forest, Colorado	6-12-40	Spring 1940	A 5x5 latin square on acidification, fertilization and mycorrhiza inoculation.
1287-1386	100	J. scopulorum C-403. Medora, N. Dak.	9-20-39	Spring 1940	A 10x10 latin square on fertilizers and acidification.

1/ Considerable germination occurred in the spring of 1942.

Table 6.--Seed beds at Towner Nursery between pipe lines 16 and 18.

Beds	No. of beds	Species	Date sown	Date germinated	Type and object of experiment
1597-1612	16	Scotch pine, C-457 Bessey District, Nebraska National Forest	1941	Spring 1941	A 4x4 latin square on acidification, fertilization, mycorrhiza introduction.
1629-1644	16	Scotch pine, C-451A Finnish seed source.	1941	Spring 1941	Do

from heavy treatments of manure, or manure plus nitrophoska, or peat plus complete commercial fertilizer plus aluminum sulphate.

Height measurements made on the two 4x4 latin squares of 1-0 Scotch pine in the fall of 1941, beds 1597-1612 and beds 1629-1644, showed considerable benefit from the acid plus superphosphate treatment and much larger differences are expected in the fall of 1942.

In the fall of 1942 from 5 to 10 trees should be removed from the Towner Experimental beds, and length of top and of root, stem diameter recorded for individual plants. For the group of plants from each bed, fresh and oven-dry weight of roots and tops is desirable. Observations on color, bud length, needle length, mycorrhiz development, and vigor may also be necessary.

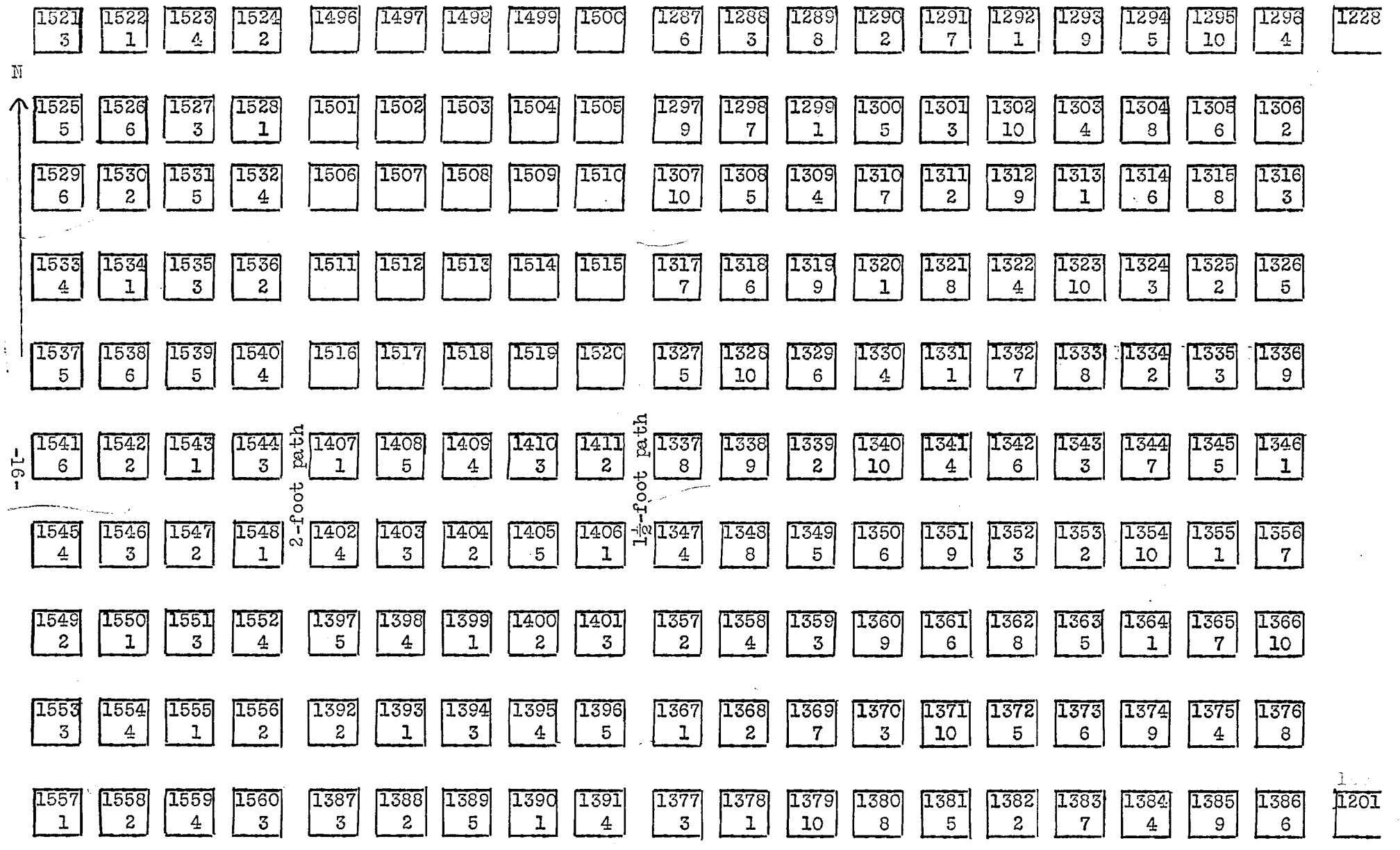
EXPERIMENTAL BEDS AT OAKES NURSERY, OAKES, NORTH DAKOTA ON WHICH MORE DATA IS NEEDED

At Oakes, North Dakota, 100 experimental beds were seeded in the spring of 1941. Of these, 40 were ponderosa pine, 40 Colorado blue spruce, and 20 Scotch pine. The beds were installed with the purpose of finding the soil treatment in acidification, fertilization and mycorrhiza inoculation necessary to gradually correct the very undesirable spotty condition of the beds in which cull sometime ran as high as 50 to 80 percent.

The treatment of each bed is shown in table 12. There are 4 replications of each treatment.

It was observed in the spring of 1942 that a high percent of the Scotch pine had brown foliage and looked almost dead, although the terminal buds seemed alive. The browning is attributed to the

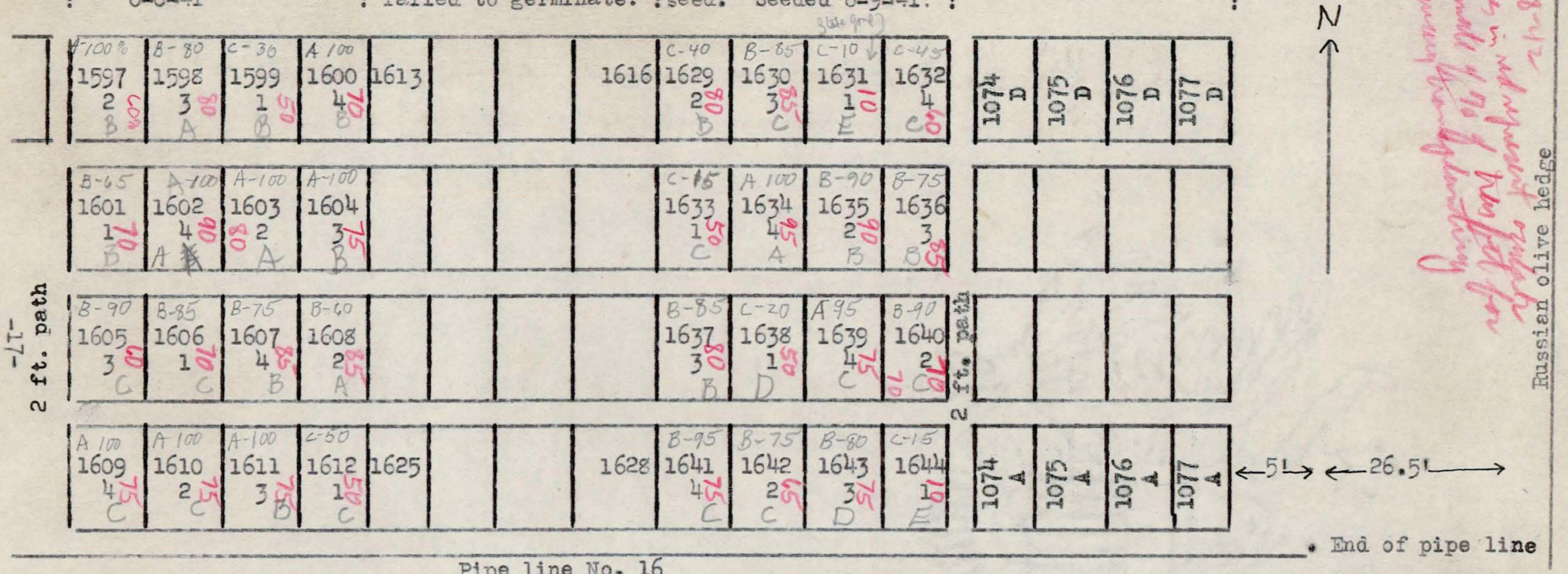
Figure 3.--Location of experimental beds on pipe lines 4 and 6, Sumner Nursery.



West edge of Bed 1521 is 40.5 ft. east of the 1-row windbreak of cottonwood and 13 ft. east of Riser.
Beds are 4 ft. north to south and 4-1/2 ft. east to west.
Top number is permanent bed number. Bottom number is treatment number.

e 4.--Location of exp imental beds north of line No. 16. Towner Nur ry, North Dakota, as of July 1, 1942.

4x4 latin square. Beds 1597-1612. Col. 457. Scotch pine. Halsey, Nebr. seed. Seeded 6-6-41	Beds 1613-1628. Unoccupied. Seeding of Larix decidua which failed to germinate.	4x4 latin square. Beds 1629-1644. Col. 451A. Scotch pine. Finnish seed. Seeded 6-9-41.	Beds 1074A, B, C, D to beds 1077A, B, C, D, unoccupied:



Pipe line No. 16

Note:-There is a 50-foot long bed of Ponderosa pine just west of bed 1597. It is Col. 453, Fallon, Mont., sown 6-9-41 Top figure in square is permanent seed bed number. Bottom figure is treatment number. Beds are 4 feet across north to south and 4½ feet long east to west between separator boards. Actual seeded area is 4x4 ft. in each bed of the two 4x4 latin squares.

Treatment No.:	Treatment per square foot of bed
1	None. Check
2	1/4 oz. H_2SO_4 + 1/4 oz. 20% superphosphate.
3	1/4 oz. H_2SO_4 + 1/4 oz. 20% superphosphate + 2 heaping tbsp. Rhinelander, Wisconsin peat.
4	1/4 oz. H_2SO_4 + 1/4 oz. 20% superphosphate + 2 heaping tbsp. Denbigh Nursery soil.

10-8-42
Figures in adjacent angle brackets for [illegible] of planting
A = mycorrhiza abundant
B = " moderately "
C = " scarce
D = " absent
0% represent 70 of trees where stock roots have mycorrhizae

Stand and seedling vig & vigor
Notes on 10-7-42
Plaud Lillow bed Number
A Good
B Fairly good
C Fair
D Poor
E Very Poor

Table 7.--Treatment of Beds 1521-1544. 2-0 J. scopulorum as of the fall of 1942. Consists of 4 replications of 6 treatments listed below. Sowed 16 grams of seed per plot, or 25.7 viable seed per sq. ft.

Treatment No.	Treatment	Permanent Bed No. Replications 1	2	3	4
1	Check. No treatment	1522	1528	1534	1543
2	1/4 Fluid ounce H_2SO_4 per sq. ft.	1524	1530	1536	1542
3	50 Tons Towner manure per acre	1521	1527	1535	1544
4	50 Tons manure + 1000 lbs 20% superphosphate per acre + 1/4 oz. H_2SO_4 per sq. ft.	1523	1532	1533	1540
5	100 Tons well drained screened Towner peat per acre + 1/4 oz. H_2SO_4 per sq. ft.	1525	1531	1537	1539
6	100 Tons Towner peat + 1000 lbs 20% superphosphate per acre + 1/4 oz. H_2SO_4 per sq.ft.	1526	1529	1538	1541

10-7-42 Stand very thin only about 10 trees per 4X4 plot

Table 8.--Treatment of Beds 1545-1560. 2-0 Blue spruce as of the fall of 1942. Consists of a 4x4 latin square. Seeded 4½ grams seed per plot or 56.7 viable seed per sq. ft. of bed.

Treatment No.	Treatment	Permanent Bed No. Replications 1	2	3	4
1	Check	1548 F	1550 F½	1555 F	1557 F
2	2 Oz. aluminum sulphate per sq. ft.	1547 ½	1549 V½	1556 F	1558 V½
3	2 Oz. aluminum sulphate + 1/2 lbs. Rhinelander peat + 1/4 oz. 15-30-15 nitrophoska per sq.ft.	1546 V½	1551 ½	1553 F	1560 F½
4	2 av. oz. aluminum sulphate + 1 lb. Denbigh Nursery soil* + 1/4 oz. 15-30-15 nitrophoska per sq. ft.	1545 ½	1552 F½	1554 ½	1559 ½

(*) Denbigh soil taken from area with good 3-3 Black Hills spruce.

Notes 10-10-42
N½= very good ½= Good F½= Fairly Good F= fair

A Mycorrhizae abundant
B Mycorrhizae moderately abundant
C Mycorrhizae scarce
D Mycorrhizae none

% = % with mycorrhizae

In red To plant bk for transplanting

Table 9.--Treatment of Beds 1496 to 1520. J. [illegible]lorum of 2 sources. No experiment involved.

Beds 1496-1505. These 10 beds were sown on September 27, 1941 with 1/2 lb. of J. scopulorum, C-440, on the 160 square feet of bed. This lot of seed had 33,112 seed per lb., a cutting test of 74 percent, and computed maximum of 24,300 viable seed per lb. amounts to 75.9 viable seed per sq. ft.

Beds 1506-1515. These 15 beds were sown September 27, 1941, with 1 lb. of seed of J. scopulorum, C-452, on the 240 square feet of bed. This lot of seed had 16,500 seed per lb., cutting test of 72 percent, and a computed maximum of 11,880 viable seed per lb., or 49.6 viable seed sown per square foot of bed.

Table 10.--Treatment of Beds 1387-1411. (This is a 5x5 latin square sown June 12, 1940 to Colorado blue spruce, C-456. In these plots 50 viable seed were sown per square foot. It will be 3-0 in the fall of 1942.)

Treatment No.	Treatment	Permanent Bed No. Replications 1	2	3	4	5
1	None	A100 1390 FG 90	A100 1393 FG 95	A100 1399 FG 90	A100 1406 G 95	A100 1407 FG 85
2	3/8 Oz. H_2SO_4	A100 1388 G 95	A100 1392 VG 100	A100 1400 FG 95	A100 1404 G 95	A100 1411 FG 90
3	1/4 Oz. 15-30-15 Nitrophoska	A100 1387 G 90	A100 1394 G 95	A100 1401 FG 90	A100 1403 G 95	A100 1410 FG 95
4	3/8 Oz. H_2SO_4 + 1 lb. Denbigh Nursery soil	A100 1391 VG 100	A100 1395 G 95	A100 1398 G 95	A100 1402 VG 100	A100 1409 FG 95
5	3/8 Oz. H_2SO_4 + 1/4 oz. nitrophoska + 1 lb. Denbigh Nursery soil.	A100 1389 VG 100	A100 1396 G 100	A100 1397 VG 100	A100 1405 G 100	A100 1408 G 95

Notes 10-7-42
entire beds had 20 to 30% of trees with foliage a bit yellowish green to light green; not unhealthy but just a little off color.
Rating as to size vigor and stand on 10-7-42 is given below
VG = Very good
G = Good
FG = Fairly good
F = Fair

Table 11.--Treatment of J. scopulorum in Beds 1287-1386.

This is a 10x10 latin square of J. scopulorum seeded September 20 and 21, 1939, using seed stratified in sand in Denbigh Station basement from January 16, 1939 to September 19,1939. The seed, C-403, from Medora, North Dakota, had 16,810 seed per lb. as sown and a cutting test of 50 percent, or sowing 37 grams per plot, or 42.8 viable seed per sq.ft.

Treatment No.	Treatment	Nursery plot in which treatment appears — Replications 1	2	3	4	5	6	7	8	9	10
1	No treatment; check	1292 B	1299 C	1313 C	1320 B	1331 B	1346 C	1355 C	1364 C	1367 B	1378 B
2	1 Oz. aluminum sulphate per sq. ft.	1290 B	1306 B	1311 B	1325 B	1334 B	1339 C	1353 C	1357 C	1368 B	1382 B
3	400 Lbs. 20% ammonium sulphate per acre	1288 B	1301 B	1316 C	1324 B	1335 B	1343 B	1352 B	1359 C	1370 B	1377 A
4	800 Lbs. 20% superphosphate per acre	1296 B	1303 B	1309 B	1322 B	1330 B	1341 B	1347 B	1358 C	1375 B	1384 B
5	200 Lbs. 50% muriate of potash per acre	1294 B	1300 B	1308 B	1326 C	1327 B	1345 C	1349 C	1363 C	1372 C	1381 A
6	20 Tons peat per acre (oven dry basis)*	1287 B	1305 B	1314 B	1318 C	1329 B	1342 B	1350 B	1361 B	1373 B	1386 B
7	20 Tons sheep manure per acre	1291 B	1298 A	1310 A	1317 B	1332 A	1344 B	1356 C	1365 A	1369 A	1383 A
8	400 lbs. ammonium sulphate; 800 lbs. superphosphate; 200 lbs. potash	1289 B	1304 B	1315 C	1321 B	1333 B	1337 C	1348 B	1362 B	1376 B	1380 A
9	400 lbs. ammonium sulphate; 800 lbs. superphosphate; 200 lbs. potash; 20 tons dry peat; 1 oz. aluminum sulphate per square foot	1293 B	1297 A	1312 B	1319 B	1336 B	1338 C	1351 A	1360 B	1374 B	1385 B
10	800 lbs. 15-30-15 nitrophoska; 20 tons sheep manure; 1 oz. aluminum sulphate	1295 A	1302 A	1307 A	1323 A	1328 A	1340 A	1354 A	1366 B	1371 A	1379 A

(*) The fresh peat was applied at the rate of 52 tons per acre and had a moisture content of 160 percent on an oven-dry basis. This is equivalent of 20 tons dry peat.

Rating as to size and vigor of beds on 10-7-42

A = Excellent
B = V G
C = Good
D =

Table 12.--Plan for t[illegible]tment of experimental [illegible] sown spring 1941 at Oak [illegible] Nursery.

Treatment No.	Treatment per sq. ft. of bed (Beds are 4' x 4')	Bed numbers: Ponderosa pine 2/	Colorado blue spruce 3/	Scotch pine 4/
1	Check; no treatment	104 116 126 132	143 158 165 175	181 187 191 196*
2	1/4 oz. sulphuric acid	107 111 121 137	142 151 166 179	182 188 195 198
3	1/8 oz. phosphoric acid	105 120 127 138	148 157 168 171	
4	1/4 oz. sulphuric acid + 4 heaping tbsp. Denbigh Nursery soil 1/	101 117 129 133	141 159 167 178	185 189 193 199
5	1/8 oz. phosphoric acid + 4 heaping tbsp. Denbigh Nursery soil	110 118 122 136	149 152 161 174	
6	4 heaping tbsp. Denbigh Nursery soil	106 119 128 131	150 160 169 180	
7	1/4 oz. sulphuric acid + pure mycorrhizal wheat culture	102 112 124 140	144 153 162 173	184 190 194 200
8	1/4 oz. sulphuric acid + 1/4 oz. nitrophoska + 4 heaping tbsp. Denbigh Nursery soil	109 113 123 139	147 156 163 172	
9	1/4 oz. sulphuric acid + 1/8 oz. superphosphate + 8 oz. manure + 4 heaping tbsp. Denbigh Nursery soil	103 115 130 134	145 154 170 177	183 186 192 197
10	1/4 oz. sulphuric acid + 4 heaping tsp. of mixed Chippewa peat and Denbigh Nursery soil 5/ + 1/4 oz. nitrophoska	108 114 125 135	146 155 164 176	

Notes made on 10/5/41 _____ Underlined in black mean beds better than average.
" " red " " poorer than average.
" " " " " poor because of drowning in low spot.

Note: 8/10/41, beds 163-169 are in a low spot where most of plants drowned out.
(*) 10/5/41, the 4 check beds have brownish foliage, the other 16 beds are quite green.

1/ For all Denbigh mycorrhizal nursery soil, use fresh soil from areas of good transplant development.
2/ Col.454, Lewis & Clark Forest, Mont. 83% on 3/6/41; 11,000 total seed per pouhd; 20.4 viable seed per gram.
3/ Col.427, Pike Forest, Colorado. 53% on 10/20/40; 103,300 total seed per pound; 120.5 viable seed per gram.
4/ Col.457, Halsey, Nebr. seed source. 58,000 seed per pound; 47% in January 1941. 60 viable seed per gram.
5/ Peat and soil mixture was made up in summer of 1940 and kept in Denbigh basement.

Scotch pine probably being of a southern strain--at least it came from Halsey, Nebraska plantations. At Towner it was observed that less browning occurred on Finnish Scotch pine than on the Halsey strain. It is hoped that at least 50 percent of the trees will recover so as to have enough stock to get information on fertilizer and acidification response.

Fertilizer application and soil inoculation

All fertilizers and mycorrhizal soil treatments were chopped into top 3 to 4 inches of the soil with a rake previous to seeding on May 28, 1941. The mycorrhizal soil was obtained from Denbigh Nursery and kept moist at all times.

Seeding

Seed sown on May 28, 1941.

In ponderosa pine sowed 3 grams seed per sq. ft. of bed.
In Colorado blue spruce sowed 1 gram seed per sq. ft. of bed.
In Scotch pine sowed 1 gram seed per sq. ft. of bed.

Acid treatment

Treated May 29, 1941. Applied in a 1 to 2 percent solution.

Treatment 7 using pure mycorrhizal cultures

The mycorrhizal cultures were grown on boiled wheat and were received May 28 at St. Paul from W. C. Davis, Assistant Forest Pathologist, Bureau of Plant Industry, Washington, D. C. They were sent to Oakes on May 28. Treatment of the beds was to be done as follows: In late June or early July after seedlings have emerged and are starting to shed their seed coats, water the beds and while soil is moist, scratch a shallow trench with a stick to a depth of 1/2 to 1 inch between each row of seedlings. Then scatter the grains of boiled wheat in trench so that the wheat grains are about 2 inches

apart. Cover immediately with the soil on ridges of the shallow trench and firm slightly with the hand or a narrow block of wood.

Treatments will be as follows:

Aminita muscaria - 1/6 pint per bed. Beds 102, 112, 144, 153, 184, 190.

Boletus granulatus - 1/12 pint per bed. Beds 124, 140, 162, 173, 194, 200.

In other words, 2 of the half-pint jars will be needed for the Aminita muscaria and 1 half-pint jar of the Boletus granulatus.

Species and beds involved

Ponderosa pine	Beds 101-140, inclusive
Colorado blue spruce	Beds 141-180, inclusive
Scotch pine	Beds 181-200, inclusive

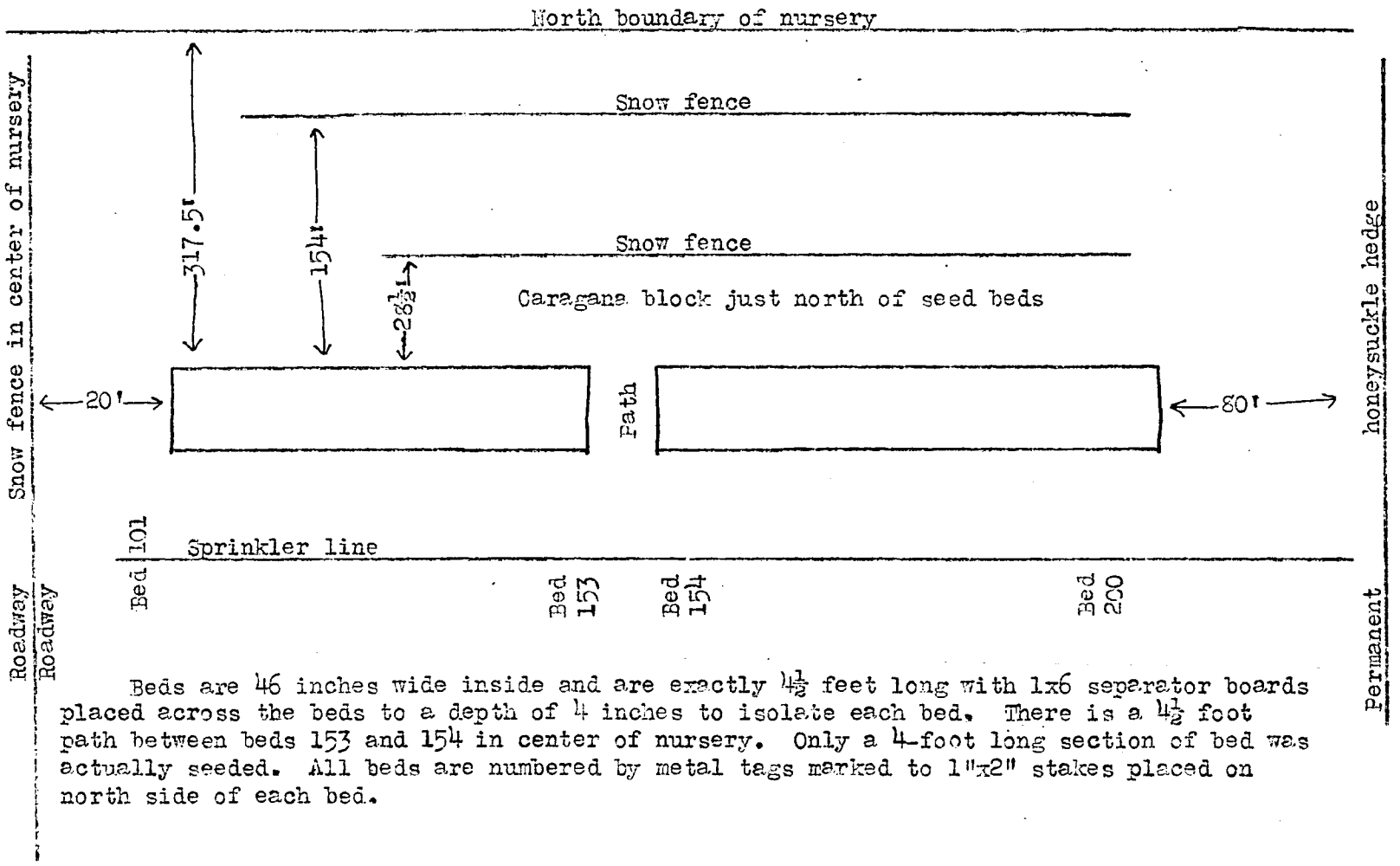
Observations and counts

At the end of the second year, in the fall of 1942, judging by past experience at Denbigh and Towner Nursery, differences in size should show up and a 100 percent count of beds will be made. Notes will be made on general appearance of the beds for color and vigor and 50 trees will be lifted from each bed and will be calipered individually to determine cull percent. In addition, 10 trees from each bed will be measured for individual length of top, of root, stem caliper, green weight of top, and of root. Observations will also be made as to the relative effectiveness of the mycorrhizal inoculations, and some of the plant material will be sent to Washington for verification of the effectiveness of inoculation.

A decision will be made later on as to whether the spruce will be left to grow to the 3-0 stage and whether any of the pine will be planted in the field for purpose of follow-up.

Check July to see if some data is there

Figure 5.--Layout of plots at Oakes Nursery.



Beds are 46 inches wide inside and are exactly 4½ feet long with 1x6 separator boards placed across the beds to a depth of 4 inches to isolate each bed. There is a 4½ foot path between beds 153 and 154 in center of nursery. Only a 4-foot long section of bed was actually seeded. All beds are numbered by metal tags marked to 1"x2" stakes placed on north side of each bed.

SNOW TRAP PLANTING AT DENBIGH

On April 22 and 23, 1942, a 7-row snow trap was planted on private land with the owner's permission on a 70-foot wide strip of land, 1408 feet long, whose west edge is about 90 feet west of the north-south road leading from U.S. No. 2 to the headquarter's building at Denbigh. The planting was started from the south end and, on April 22, 162 trees in each row were planted by Stewart, Jacobson and Stoeckeler. On April 23 the north 191 trees of each row were planted. All told, 2471 trees were planted in the snow trap. Space between rows was 8.5 feet and between all plants in the row regardless of species it was 4.0 feet. Data on the snow trap planting is given in table 13.

Table 13.--Data on Denbigh snow trap planting. Spring 1942.

Row No.	Age class and species	Col. No. and seed source	No. of trees planted	Planted by
1	1-0 Russian olive	North Dakota	353	A. Jacobson
2	2-0 Green ash	North Dakota	353	A. Jacobson
3	1-0 Boxelder	North Dakota	353	J. Stoeckeler
4	1-0 Boxelder	North Dakota	353	J. Stoeckeler
5	2-0 Green ash	North Dakota	353	J. Stoeckeler
6	2-2 Ponderosa pine	Col. 438, Fallon, Montana	353	H. Stewart
7	Top pruned 2-2 J. scopulorum*	Col. 387, seed bed 348, Medora, North Dakota	353	H. Stewart

*Top pruned at 6" height in summer of fourth year in nursery.

This area was plowed in September 1941 with the same one-way disk plow used in renovating the 140 acres of plantation. Then it was double disked with a sand bagged disk. The area was in good shape for planting in April 1942, except for a few swales where the disk plow failed to cut as deeply as necessary through the heavy sod cover. This will probably necessitate cross disking the area

in 1942 with the small disk made for special jobs at Denbigh.

Since we have grown no conifers so far which were cross disked, it is suggested that survival counts and height data be kept on this snow trap to supplement that from the underplanting done in P-65 in the spring of 1942.

FIELD PLANTING AND REPLANTING AT DENBIGH SPRING 1942

A small amount of field planting and replanting, totaling 11,791 trees, was done at Denbigh in the spring of 1942, all of it on existing plantations and none of it on new land. The purpose was to fill in gaps in old plantations with low survival and to test on a small scale limited lots and sources of stock not planted to date at Denbigh. The record of this planting is given in tables 14 to 18, inclusive.

Some replanting still remains to be done and the detailed data in the 1941 annual report for North Dakota in table 10, pages 51-58, can be used as a basis for future replanting.

The tracings referring to the plantations will need to be corrected to include this spring's planting as well as the detailed records of planting given in the 1941 annual planting report for North Dakota.

CULTIVATION TO BE DONE AT DENBIGH IN 1942

Cultivation at Denbigh will include all of the areas shown in figure 11 of the 1941 annual North Dakota planting report, except that P-66, the most easterly strip of cottonwood in the NW of SE, was elected in May 1942 to be left without cultivation to see if the past two years of cultivation on this strip would bring the trees through

Table 14.--Spring 1942 record of replanting in NE of SW of Sec. 36, T. 156 N., R. 78 W., Denbigh, North Dakota.

Plantation No.	Row No.	Age class	Species	Col. No.	Seed source	Planted by	No. trees planted	Date planted
P-51	87	1-0	Black locust	ST 1411	Idaho	J. Stoeckeler	288	4-28-42
P-51	88	1-0	Black locust	ST 1411	Idaho	A.Jacobson	319	4-28-42
P-51	89	1-0	Black locust	C-504	E.Tawas, Mich.	H. Stewart	372	4-28-42
P-51	90	1-0	Manchurian ash	C-454A	U.S.S.R.	A. Jacobson	253	4-28-42
P-51	91	1-0	Manchurian ash	C-454A	U.S.S.R	Stewart and Stoeckeler	299	4-28-42

Table 15.--Spring 1942 Record of Replanting in E½ of NW SW, Section 36, Denbigh Station, North Dakota. (Trees from Towner Nursery.)

Plantation No.	Row No.	Age class	Species	Col. No.	Seed source	Bed No.	Planted by	No. planted	Date planted
P-24C	1R	3-0	Ponderosa pine	441	Fallon, Mont.	1101	J. Stoeckeler	50	5-9-42
	2R					1102	A. Jacobson		
	3R					1103	J. Stoeckeler		
	4R					1104	A. Jacobson		
	5R					1105	J. Stoeckeler		
	6R					1106	A. Jacobson		
	7R					1107	J. Stoeckeler		
	8R					1108	A. Jacobson		
	9R					1109	J. Stoeckeler		
	10R					1110	A. Jacobson		
	11R					1121	J. Stoeckeler		
	12R					1122	A. Jacobson		
	13R					1123	J. Stoeckeler		
	14 R					1124	A. Jacobson		
	15R					1125	J. Stoeckeler		
	16R					1126	A. Jacobson		
	17R					1127	J. Stoeckeler		
	18R					1128	A. Jacobson		
	19R					1129	J. Stoeckeler		
	20R					1130	A. Jacobson		
F	21R					1141	J. Stoeckeler		
	22R					1142	A. Jacobson		
	23R					1143	J. Stoeckeler		
	24R					1144	A. Jacobson		
	25R					1145	J. Stoeckeler		
	26R					1146	A. Jacobson		
	27R					1147	J. Stoeckeler		
	28R					1148	A. Jacobson		
	29R					1149	J. Stoeckeler		
	30R					1150	A. Jacobson		
P-24E	31R					1161	J. Stoeckeler		
	32R					1162	A. Jacobson		
	33R					1163	J. Stoeckeler		
	34R					1164	A. Jacobson		
	35R					1165	J. Stoeckeler		
	36R					1166	A. Jacobson		
	37R					1167	A. Jacobson		5-11-42
	38R					1168	A. Jacobson		
	39R					1169	A. Jacobson		
	40R					1170	A. Jacobson		

The above comprise 4 replications of a 10 × 10 Latin square arrangement of treatments randomized and fully tied in 3-0 Ponderosa at Towner Nursery.

e 15.--(Continued)

Planta-tion No.	Row No.	Age class	Species	Col. No.	Seed source	Planted by	No. planted per row	Date planted
P-24F	41R	3-0	Scotch pine	385	Finland	J. Stoeckeler	50	4-30-42
	42R					H. Stewart		
	43R					A. Jacobson		
	44R					J. Stoeckeler		
	45R					A. Jacobson		
	46R					H. Stewart		
	47R					J. Stoeckeler		
	48R					H. Stewart		
	49R					A. Jacobson		
	50R					J. Stoeckeler		
P-24F	51R	3-0	Scotch pine	427	Leningrad, U.S.S.R.	A. Jacobson	50	
	52R					H. Stewart		
	53R					J. Stoeckeler		
	54R					A. Jacobson		
	55R					H. Stewart		
	56R					J. Stoeckeler		
	57R					A. Jacboson		
	58R					H. Stewart		
	59R					H. Stewart		
	60R					A. Jacboson		

T 15.--(Continued)

Plantation No.	Row No.	Age class	Species	Col. No.	Seed source	Data on stock	Planted by	No. planted per row	Date planted
P-24iR	85R	3-0	Ponderosa pine	376	Black Hills, S.D.	Top pruned	J. Stoeckeler	50	4-30-42
	86R						J. Stoeckeler		
	87R						J. Stoeckeler		
	88R						J. Stoeckeler		
	89R						H. Stewart		
	90R						H. Stewart		
	91R					Not top pruned	A. Jacobson		
	92R						A. Jacobson		
	93R						J. Stoeckeler		
	94R						J. Stoeckeler		
	95R						H. Stewart		
	96R					Top pruned	H. Stewart		
	97R						A. Jacobson		
	98R						A. Jacobson		
	99R						J. Stoeckeler		
	100R						H. Stewart		
	101R					Not top pruned	A. Jacobson		
	102R						J. Stoeckeler		5-2-42
	103R						H. Stewart		
	104R						A. Jacobson		
	105R						J. Stoeckeler		
	106R					Top pruned	H. Stewart		
	107R						A. Jacobson		
	108R						H. Stewart		
	109R						A. Jacobson		
	110R						H. Stewart & A. Jacboson		

Table 15.--Record of nursery seed bed treatment of 3-0 Ponderosa pine planted in P-24C, P-24D, and P-24E in E½ of NW SW of Section 36.1/

Nursery Treatment No.	Treatment in Nursery	Trees from Nursery bed number				Field planted in field row number P-24C		P-24D	P-24E
1	1/2 Lb. Denbigh Nursery soil	1102	1128	1150	1164	2R	18R	30R	34R
2	Check	1106	1121	1143	1169	6R	11R	23R	39R
3	1/4 oz. 20% superphosphate	1101	1123	1147	1168	1R	13R	28R	38R
4	1/4 Lb. Chippewa Forest peat + 1/4 oz. sulphur + culture of Boletus granulatus	1108	1122	1145	1166	8R	12R	25R	36R
5	1/4 Lb. Chippewa Forest peat + Boletus granulatus culture	1105	1127	1149	1170	5R	17R	29R	40R
6	1 Lb. sheep manure + 1/4 oz. superphosphate	1110	1125	1146	1162	10R	15R	26R	32R
7	1/4 oz. 15-30-15 nitrophoska	1107	1129	1148	1161	7R	19R	28R	31R
8	1/4 oz. sulphur	1104	1126	1141	1165	4R	16R	21R	35R
9	1/2 oz. Sulphur	1109	1124	1142	1163	9R	14R	22R	33R
10	1/2 Lb. Denbigh Nursery soil + 1/4 oz. superphosphate + 1/2 oz. sulphur	1103	1130	1144	1167	3R	20R	24R	37R

1/ In the long run the field planting of 4 out of 10 replications of this latin square should indicate whether mycorrhizae are essential to long time survival and growth of ponderosa pine.

50 trees planted of each lot X 4 replications = 200

Table 16.--Record of Spring 1942 Replanting in W½ NW SW Section 36, Denbigh Station, North Dakota

Plantation No.	Row No.	Age class	Species	Col. No.	Seed source	Planted by	No. planted per row	Date planted
P-27B	1R	3-0	Ponderosa pine	C-441	Fallon, Mont.	A. Jacobson	100	5-13-42
	2R							
	3R							
	4R							
	5R							
	6R							
P-27D	23R	3-0	Ponderosa pine	C-441	Fallon, Mont.	A. Jacobson	100	5-13-42
	24R							
	25R							
	26R							5-14-42
P-31B	20R	3-0	Ponderosa pine	C-441	Fallon, Mont.	A. Jacobson	100	5-14-42
	21R							
	22R							
	23R							5-15-42
	24R							
	25R							
	26R							
	27R							5-19-42
	28R							
	29R							
	30R							
	31R							
P-31C	32R	3-0	Ponderosa pine	C-441	Fallon, Mont.	A. Jacobson	100	5-19-42
	33R							
	34R							
	35R							5-20-42
	36R							
	37R							
	38R							
	39R							
	40R							
	41R					H. Stewart		
	42R					A. Jacobson		
	43R					H. Stewart		

Table 17.--Record of Spring 1942 Replanting in SE of SW of Section 36 at Denbigh Station, North Dakota.

Plantation No.	Row No.	Age class	Species	Col. No.	Seed source	Planted by	No. planted per row	Date planted
P-57	1	1-1	J. virginiana	B-39-25	Oakes, N.D.	A. Jacobson	200	5-20-42
	2					H. Stewart		5-21-42
	3					A. Jacobson		
	4					H. Stewart		
	5					A. Jacobson		
P-57A	1	1-1	J. virginiana	B-39-25	Oakes, N.D.	A. Jacobson	200	5-20-42
	2					A. Jacobson		
	3					H. Stewart		
	4					H. Stewart		
	5					A. Jacobson		

Table 18.--Record of April 14, 1942 underplanting of 2-year-old cottonwood in P-65 in NW of SE of Section 36 at Denbigh Station, North Dakota.

Sub-plot	Age class	Species	Col. No.	Seed source	Total No. planted
1*	1-1	J. virginiana	B-39-25	Oakes, North Dakota	100
2	3-2	Colorado blue spruce	420	San Isabel National Forest, Colorado	100
3	3-0	Ponderosa pine	441	Fallon, Montana	100
4	3-2	J. scopulorum	403	Medora, North Dakota	100
5	3-2	Scotch pine	427		40
6	Cuttings	Diamond willow	--	Larimore, North Dakota	40
7	3-2	Jack pine	399	Chippewa National Forest, Minnesota	40
8	2-0	Green ash	--	North Dakota	40

Each subplot consists of 4 rows of either 25 or 10 trees per row, interplanted between rows of 2-year-old cottonwoods, which are spaced 9x9 feet. The underplanted trees are between the rows of cottonwood on the intersection of diagonals drawn from one cottonwood at a 45 degree angle to the tree of the same species in the next row. Subplot No. 1 is at north end of P-65, while subplot 8 is at the south end of P-65, with the other species appearing in the order given above.

without further cultivation. This strip was to be cultivated in 1942 only in case, in the judgment of Harold Stewart, the trees would certainly die without one or two cultivations. It is expected that the trees may have small leaves and poorer vigor than the other adjoining cultivated belts, but still would be able to survive and grow moderately well without further care.

Note. It was given one cultivation late in 42 when lyany mostly appeared imminent and was actually given in 1943 and 1944

The underplanting in P-65, involving conifers and hardwoods planted in the spring of 1942 under 2-year-old cottonwood, will need cultivation, using the Allis Chalmers tractor and shovel cultivators to straddle the interplanted trees. The trees in P-61 to P-64 can probably best be handled with a shovel cultivator, perhaps the A.C., with cultivation done mostly the long way of the rows. If any cross cultivation is done, it should be needed only once. The juniper in P-10B should be cultivated with the A.C., using shovel equipment in straddling position.

The snow trap planting made in 1942 will need cultivation and disking the long way and will probably need some cross disking with the 3-foot-wide disk made for narrow rows and using the A.C.

The planting of juniper just west of the residence has such narrow rows that only the A.C. tractor can be used along with the narrow disk. Once the sod has been thoroughly pulverized, it is suggested that the regular shovel equipment on the A.C. should suffice for taking care of the above juniper plantation.

The regular arboretum north of the nursery residence can be best handled with the A.C. and the duckfoot shovels by straddling the tree rows. Such tractor cultivation should be continued only so long as there is no serious skinning up of bark and branches, or injury to terminal buds of conifers. As soon as this occurs, hand hoeing should

be relied on to clean out the weeds in plots with fairly large trees. In the spring of 1942 the cottonwood, boxelder, and Russian olive were already so large that no tractor cultivation could be used.

Other cultivation will include the windbreaks west, north and east of the residence and an occasional cultivation of the two rows of cottonwood planted in the ditch of the road leading north to U. S. Highway No. 2. If weed growth in P-24C, P-24D, and P-24E gets too rank in 1942, it will be given one cultivation even though it was originally set up for no more cultivation.

The rule for all cultivation at Denbigh should be to cease using the disk as soon as possible and resort to shovel cultivation so as not to destroy the root-laden clods of soil which are such an aid in reducing soil blowing.

A record of all cultivation by dates should be kept on a set of maps similar to figure 11 in the 1942 report, which shows the various types of cultivation areas at Denbigh. These are to be kept on file at Denbigh.

REDUCTION OF SOIL BLOWING IN DENBIGH ARBORETUM

To reduce soil blowing in Denbigh arboretum, a thin layer of compost and of heavy soil should be put on the surface of the blow spots. This material is in two piles south of the garage, about 200 feet. In late summer of 1942 the arboretum should be given intensive protection by putting three additional lines of snow fence through the arboretum in an east-west direction between each row of arboretum plots where the 11-foot space was left. Some fence may also be necessary in a north-south direction.

Another possibility is seeding of a crop of rye in August on all the 11-foot strips between plots and irrigating it with sprinklers to get a stand. In the spring of 1943 this could be ripped up with the A.C. shovel cultivators, or left in place and mowed with the power mower, preferably the latter.

IRRIGATION AND WATERING TO BE DONE AT DENBIGH IN 1942

Irrigation with a hose will be carried on intensively in the Denbigh arboretum, especially on all planting done in the spring of 1942. The lining out stock at west end of Denbigh arboretum and also south of the garage will be kept watered.

All ornamentals around the house, and especially the poplars west of the implement shed, and the conifers at the entrance on U.S. No. 2 will need an occasional watering.

MOWING TO BE DONE AT DENBIGH IN 1942

The entire area bounded by the windbreaks on the north, west and east side of the house will be kept mowed as in past years, and extending south fairly close to the anemometer stand.

WEATHER AND OTHER RECORDS

Rainfall records are to be kept the year round. The data on water table fluctuation should be ended December 1 and started April 1. It may be necessary to chop a hole in the ice in the spring to get the measurement to the water surface and not to the ice. If ice is present and the measurement is taken to the ice, it should be so indicated in the record. A mulch of straw and sod mounded over the wells made in December will enable one to get a measurement in early spring without having to cut out the ice.

A record on maps must be kept of all cultivation showing area and dates. A record of gas and oil used by dates and type of equipment

must be kept and a report issued at end of each month on the amount of gas on hand in the tanks or barrels, and the amount used in the past month by dates and types of equipment. An alternative would be to send to St. Paul, for compilation by Mrs. Seaman, the original tabulation sheet record with a notice of gas on hand in tanks and barrels.

OTHER JOBS TO DO AT DENBIGH STATION IN 1942

1. Install new well curb and hydrant pit curb. This is a very high priority job and must be done this summer. In building the well curb it is suggested this be assembled directly under the windmill tower, using 1x2 material of such a size that the new curb will fit inside the old one with a little margin to spare, and with the lower part of the north side left off,or with one 4-inch space left horizontally so that the resultant opening will slip over the horizontal intake pipe which connects with the 2-inch sand points. The shell should be given three brush treatments of creosote at intervals of several days so the sun will aid in getting penetration of the creosote. When dried the top of the present well pit will be removed, the new curb lowered into the pit with a block and tackle, and the space between the old and new curb packed with moist sand, perhaps washing it down with a hose and tamping. The top of the present well pit should still be serviceable.

2. While the new well pit curb is being installed and before the cover is replaced, the present sand point attached to the windmill should be pulled and the pump cylinder checked. It will certainly need new leathers and perhaps the entire cylinder will need replacement, since it has been in use some 11 years.

3. Throughout the field plantations and the snow trap planting there are a few places where heavy clumps of dwarf willow and other species can be grubbed out so as to make shovel cultivation easier. These could be spotted by Stewart and shown to Jacobson, who would do the grubbing. It is possible that if most of the grubbing were done beforehand a chain could be wrapped around the plant and jerked out with the Minneapolis-Moline tractor in lowest gear.

4. The road ditch, just south of the entrance to the Station in the northwest corner of the section, should be filled in in such a manner that Kelly and other ranchers can drive straight south along the section line without driving through the parkway between buildings.

5. The soil for the ditch fill mentioned above could be taken from the pile near the present loading dock, which should be deepened and changed so that tractors and other equipment can be unloaded without getting stuck in the loose sand. Scrap lumber can be used to make a runway and a vertical wall to keep the soil from crumbling.

6. The sand points in the field in the southwest corner of the NW of SW could be pulled or dug out.

7. It would be desirable to pull the sand points, to which the Fairbanks-Morse engine is attached, to clean these with muriatic acid and a steel brush. Check for any breaks or holes, and reset them in the well. It is believed there will be less flow of sand into the water system once this is done. At the same time, it may be possible to check over the pipes and fittings in the well pit and replace such fittings as are required.

8. The road leading to Highway U.S. No. 2 needs some repair. It is suggested that the surface of the holes in the road be chopped

up with a pick to give a rough surface that will "hold" better the 50-50 mixture of clay and gravel which is used to fill the holes. Tamp fill with large end of a cedar post. Then, with the Minneapolis-Moline tractor, drag the road with the heavy section of steel rail near the snow fence enclosure south of the residence.

9. The stove pipe in the garage must be repaired and the asbestos protection near the roof checked. At present this is a serious fire hazard and should be repaired at the earliest possible moment. If someone should by accident or design light the stove it would probably result in a serious fire in the garage. All inflammable trash in the stove should be immediately removed pending repair of the stove pipe.

10. The oil in the Fairbanks-Morse pump and also in the engine should be completely drained out several times during the summer, flushed out with kerosene, drained, and new oil added. Oil in the Minneapolis-Moline tractor will probably need change every 60 to 100 hours of running time. For the A.C. the recommendations in the operation's book should be followed. Air pressure in the rear tires of the Minneapolis-Moline tractor should be maintained at 9 to 12 lbs. and in the A.C. at 15 to 17 lbs. Check frequently.

11. All fire hose not in use and now stored in the garage should be moved into the northwest corner of the office room in the residence. There are two lots of this in the garage. The one in the extreme northwest corner was fairly good hose, while that closer to the center of the garage was poorer or defective hose, which could be used for splicing, etc. The two lots should be kept separate in the office and labeled "good hose" and "defective hose." The garage roof is too hot as an ideal storage place for rubber lined canvas hose, while the

basement is so damp that the cotton fabric may rot.

12. Snow fences around the Station can be tightened where necessary and wired up.

13. All equipment should be kept under cover at all times when not in use, except for the disk which we decided this spring could be left in the field because, if brought to the Station each night, it tended to tear up the sod and lawns excessively. The unitiller should be put on blocks in the implement shed if not in use.